Pellergy LLC

A Renewable Energy Company

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Grass Combustion: Technology Gaps in Current Home Heating Options

Introduction

- Grass combustion technologies
- The "Combustion System" is not just a stove, boiler or burner…
- Identifying the current technology gaps
- Systems Engineering Approach in identifying a solution

Grass Combustion

- Undensified or Densified Grass for Combustion?
  - Undensified Grass is well suited for large-scale industrial and commercial uses, but is not practical for smaller scale or home heating.
  - Densified Grass is well suited for home heating applications. It allows for better:
    - Transportation, Storage, Standardization of Product, ,

Combustion Technologies

- Densified Grass
  - 100% Grass Pellets or Briquettes
    - Pellets are generally ¼" form factor
    - Briquetts mills are making 1-2" product
- We can Grow Grass, We can Densify It…and It Burns.
  - Why does New England still have 6.2 Million Homes heating with Oil?
    - **Combustion Technology**: This is where we need to focus!
    - Modifying or compromising with wood pellet technologies is a stop-gap measure. We need to focus on development.

Test Burn of 100% Reed Canary Grass Pellets in a Pellergy PB3550, July 2008

Technology Gap Areas

1. Standardization of the Fuel
   - Standards for size, density, ash & mineral content, moisture, and btu value should be established
2. Fuel Handling and Storage
   - Bulk fuel handling, storage and transportation technologies must be developed for the small-scale user
3. Combustion Techniques
   - Specialized techniques are utilized due to the combustion properties and mineral impurities of densified grasses.
4. Ash Control
   - Grass = Higher Ash….Period
5. Heat Exchanger Surfaces
   - Corrosion tends to be an issue in biomass boilers due to the impurities associated with the fuel
6. Air Pollutants
   - NOx and particulate emissions are higher when burning grasses

Technology Gap Areas

Standardization of the Fuel

- We need to work within the limits of current densification technologies
  - Broad ranging from multi-million dollar pelletizing mills to a $40,000 briquetting machine
  - Set the requirements based upon:
    - Form Factor
    - Quality Range of the Feed Stock
  - Fuel size, density, ash & mineral content, moisture, and btu value must be controlled within manageable limits
- "Let wood pellets be wood pellets" and set the standards according to the capabilities of grass as a fuel. Do not set unrealistic standards given today's densification technologies

Technology Gap Areas

Fuel Handling and Storage
- Bulk fuel handling, storage and transportation technologies must be developed for the small-scale user
- Site-specific bulk storage and handling systems will be needed to support demand for bulk product
  - This must be adaptable, scalable and affordable
  - Leverage existing pelletized fuel and feed technologies

Pellergy Pilot Project Installation, Montpelier, VT 2007 Wood Pellet Delivery

European Installation, 2005 Wood Pellet Delivery

Technology Gap Areas

Combustion Techniques
- Slagging and Fouling of the combustion chamber needs to be accounted for given the mineral content of grasses.
- There are mitigating factors that can be employed in engineering the fuel; however, designing a combustion system to account for the impurities is the best long-term approach
  - Fluidized Bed Gasification
  - Active Grate Firing: Traveling, Vibrating, Cascading or Reciprocating
  - Combustion Chamber Agitation

Technology Gap Areas

Ash Control
- Grass contains higher ash content than premium wood pellet fuel.
  - Fly ash contains the alkali metals and Chlorine which are leading agents in heat exchanger corrosion. It is critical to control ash deposits and remove ash from the system
  - Active ash control systems
    - Mechanical: scrape, brush, agitate
    - Pneumatic: blow-down
  - Accumulated ash removal by bottom auger

Technology Gap Areas

Heat Exchanger Surfaces
- Corrosion
  - Potassium and Chlorides cause corrosion in the heat exchanger surfaces
  - There are methods for controlling the amount of these impurities in the fuel
    - Harvest time, fertilizing, soil choice, etc.
    - Addition of Silica or Limestone to fluidized bed
  - There are management methods that can be implemented within the combustion system to increase reliability and performance
    - Metallurgical
    - Gas-flow and heat transfer
  - Ash needs to be managed to insure efficiency and control corrosion

Technology Gap Areas

Air Pollutants
- NOx is increased due to the increased levels of Nitrogen in the grasses.
  - Reduce fertilization in as much as possible
  - Control Nitrogen content as a function of the fuel
  - Engineer the combustion system for the proper utilization of combustion air: Proper sir distribution is essential
- Particulate emissions are greater with grasses due to the increased ash content of the fuel.
  - Some grasses have lower values
  - Consider the use of advanced methods such as Electrostatic Precipitators in the removal of particulates from the exhaust gas stream
    - Small scale systems developed in Switzerland and Germany have proven reductions in particulate emissions (20-65%) and use only 12W of power.

Conclusion

- While it is possible to burn densified grasses in some of today's combustion appliances, boilers and burners; the need exists to take a Systems Engineering approach in developing a grass energy system for small scale heating.
  - The system must take into account each of the technology gaps identified
  - Leveraging existing work done in Europe and the US will mitigate the development risks

Questions?

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